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Western Land Managers will Need all Available Tools for Adapting to Climate Change, Including Grazing: A Critique of Beschta et al.

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Abstract In a previous article, Beschta et al. (Environ Manag 51(2):474–491, 2013) argue that grazing by large ungulates (both native and domestic) should be eliminated or greatly reduced on western public lands to reduce potential climate change impacts. The authors did not present a balanced synthesis of the scientific literature, and their publication is more of an opinion article. Their conclusions do not reflect the complexities associated with herbivore grazing. Because grazing is a complex ecological process, synthesis of the scientific literature can be a challenge. Legacy effects of uncontrolled grazing during the homestead era further complicate analysis of current grazing impacts. Interactions of climate change and grazing will depend on the specific situation. For example, increasing atmospheric CO_2 and temperatures may increase accumulation of fine fuels (primarily grasses) and thus increase wildfire risk. Prescribed grazing by livestock is one of the few management tools available for reducing fine fuel accumulation. While there are certainly points on the landscape where herbivore impacts can be identified,

Beschta et al. 2013 (see Literature cited)

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there are also vast grazed areas where impacts are minimal. Broad scale reduction of domestic and wild herbivores to help native plant communities cope with climate change will be unnecessary because over the past 20–50 years land managers have actively sought to bring populations of native and domestic herbivores in balance with the potential of vegetation and soils. To cope with a changing climate, land managers will need access to all available vegetation management tools, including grazing.

Keywords Grazing · Public lands · Climate change · Riparian areas

Beschta et al. (2013) suggest that grazing on public lands (by livestock, feral herbivores such as "wild" horses and burros, and native ungulates) should be greatly reduced or eliminated as a means of improving the capacity of native vegetation communities to cope with climate change. We dispute the notion that eliminating grazing will provide a solution to problems created by climate change, and focus on three primary points: (1) grazing is a complex ecological process and a single recommendation (e.g. eliminate grazing) is unlikely to be universally correct, (2) there are legacy effects of livestock grazing from the homestead period that are separate from current day impacts, and (3) climate change is likely to increase the risk of large wildfires and grazing is one of the few available tools for landscape-level fuel reduction.

Complex issues in natural resource management have been defined as those which vary in time and space (Boyd and Svejcar 2009); thus one answer is not correct in all places or during all periods. Grazing certainly qualifies as a complex issue. The impacts of grazing depend on the timing, intensity, and frequency, as well as, type of animal (Heitschmidt and Stuth 1991). The impacts of grazing can be negative as Beschta et al. (2013) point out. But there are examples of positive effects of grazing on landscape diversity and habitats of individual species (Austin et al. 1994; Clark et al. 2000; Fuhlendorf et al. 2006), thus broad generalizations do not capture the impacts of grazing, even without the complicating effects of climate change.

Because of the complex nature of grazing, it is possible to find the literature to support a variety of points of view. We suggest that Beschta et al. (2013) have selected individual studies and parts of studies which support their central thesis rather than presenting a complete synthesis of the topic. For example, they cite publications by Love (1959) and Blackburn (1984) to support their observation that "livestock have had numerous and widespread negative effects to western ecosystems." Complete reading of these texts indicates that both authors acknowledged that historic *heavy* grazing had negative impacts, but by the time (1984) Blackburn reviewed the available scientific literature he had found a number of hydrologic research projects that had "failed to show a difference in soil loss, infiltration capacity, or soil bulk density among light, moderate and ungrazed pastures". Obviously, the Beschta et al. statement about negative ecosystem effects applies only to areas that had been heavily grazed and not to those with more appropriate stocking rates. Furthermore, these authors do not refer the more recent publications highlighting grazing strategies that are compatible with sustainable riparian area management (e.g. Chaney et al. 1993; Wyman et al. 2006). Given the emphasis of Beschta et al. (2013) on riparian areas and wildlife habitat, it is interesting to note that position statements by the American Fisheries Society (Armour et al. 1991, current version available on American Fisheries Society website) and The Wildlife Society (2010) do not advocate removing livestock from western rangelands. Rather the position statements recognize that informed management and the use of appropriate science can result in a positive outcome for a variety of rangeland resources.

There are also legacy effects of past livestock grazing and it can be challenging to separate these legacy effects from current grazing impacts. During the early 1900s, there was heavy and completely unmanaged livestock grazing on vast tracts of public land. The land was not intended to remain in public domain, but the various "Homestead Acts" allocated insufficient land to private ownership to sustain family-scale agricultural and ranching operations on western rangelands as was the intent. This required the use of additional non-patented lands by homesteaders to support their livestock. Unfortunately, there was no plan for managing grazing on these public lands at the time. Passage of the Taylor Grazing Act of 1934 created a system for managing livestock and adjusting livestock numbers on most public lands of the West. But this was just the first step in repairing the damage caused by overgrazing. Much was still to be learned about grazing management, especially with respect to the 1–2 %

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of the landscape around streams and wetlands—the riparian areas. Unfortunately, these stream-side areas did not receive the attention they deserved until after the 1970s or 1980s in many areas. The point to this discussion is that research was needed to document the impacts of heavy season-long grazing and provide guidance on appropriate management and stocking rates. The research was necessary to determine appropriate timing of grazing and numbers of livestock. These changes have been implemented over large areas, as Beschta et al. (2013) show in their Figure 2, with livestock numbers on Bureau of Land Management (BLM) land dropping by 50 % from the 1950s to 2000s (also see Wagner 1978). Yet these authors use many of these decades' old studies to argue that current levels of grazing are inappropriate when in fact the criticism does not apply to landscapes now under accepted grazing practices and stocking rates. Furthermore, for riparian management in large allotments, animal distribution rather than animal numbers per se is often the main issue. Shortened periods of use and planned periods for recovery provide greater effect (e.g. George et al. 2011) than just reducing numbers.

Much of the climate change literature cited by Beschta et al. (2013) has little to do with grazing. And attempting to link grazing and climate change, two complex issues, is no small challenge. However, many of the cited climate change articles suggest wildfires will become more frequent and severe. We would add that biomass of flammable invasive annual grasses is increased by higher CO_2 levels (Ziska et al. 2005) which further increases fire risk. Grazing is one of the few tools available to reduce the herbaceous vegetation that becomes fine fuel on rangelands, particularly at large spatial scales. This is especially true if invasive annual grasses are present (e.g. Diamond et al. 2012). Native bunchgrasses also can be more susceptible to fire mortality when they are not grazed because litter accumulates near their growing points; bunchgrass mortality opens the plant community to invasion by exotic annuals (Davies et al. 2009). These situations provide examples of the importance of maintaining grazing as a vegetation management tool.

Beschta et al. (2013) devote a significant portion of their climate change discussion to warmer spring temperatures, reduced snow packs, earlier peak flows, and reduced summer stream flows. It is unclear how removing grazing would overcome the effects of large-scale climatic changes (such as reduced snow packs) that are triggered by larger and more complex resource issues than grazing. Some of the discussion on carbon sequestration is particularly unclear. For example, Beschta et al. (2013) cite Lal (2001) as saying that heavy grazing has long-term negative impacts on soil organic carbon. That citation is a chapter in a book titled "The Potential of US Grazing Lands to Sequester Carbon and Mitigate the Greenhouse Effect" (Follett et al. 2001). This book provides examples where grazing increases carbon sequestration compared to no grazing.

Beschta et al. (2013) suggest that the economic impacts of their proposal would be "relatively minor to modestly positive". That may be true for unique areas with high recreational potential such as Jackson Hole, Wyoming, but it is not true for most of the rural West and not necessarily for even some of the high value recreation areas. A few studies have examined the regional economic impact of removing public land grazing from representative ranches and all show significant negative impacts to local economies (Torell et al. 2002; Rimbey et al. 2003; Tanaka et al. 2007). Whether recreation service jobs will replace ranching jobs and income lost in a local economy is largely unknown.

To summarize, grazing is a complex ecological process with impacts that vary across time and space. This complexity leads to challenges in synthesizing the scientific literature and allows authors to select the literature which supports particular points of view about grazing impacts. Legacy impacts of homestead era over-grazing and potential climate change further complicate assessment of current grazing impacts. Clearly, there are examples where reduced grazing can increase the potential negative impacts of climate change (in the case of wildfire risk). We suggest that land managers in the western US will need all available vegetation management tools to cope with climate change.

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